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TRANSLATIONS ON THE METALLURGICAL INDUSTRY OF COMMUNIST CHINA

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TRANSLATIONS ON THE METALLURGICAL INDUSTRY OF COMMUNIST CHINA

Following is a translation of selected articles from various issues of the Chinese-language periodical Yeh-chin Pao (Metallurgical Bulletin), Peiping. Date of issue, page, and author, if any, are given under individual article headings.

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1. Methods of Calculation for the Ore Dressing Indicators
with Regard to Ferrous and Non Ferrous Metals

No 32, 7 August 1959
Pages 38-39 (full translation)

Production Techniques
Bureau, Ministry of
Metallurgical Industry

A. Grinding Machine Utilization Coefficient:

1. Calculated according to unit volume production:

$$\frac{Q \text{ (metric ton)}}{\sum AT} = \text{metric ton / cubic meter-hour}$$

2. Calculated according to quantity of newly made minus 200 mesh products: For convenience in calculation, only the first stage grinding is considered no matter how many stages of grinding are done. The formula is as follows:

$$\frac{Q \text{ (metric ton)} \times (B_1 - B_2)}{\sum A_1 T_1} = \text{metric ton / cubic meter-hour}$$

In the above formulas:

Q = Plant intake actual quantity of ore handled in a month (calculated on dry basis);

B₁ = Percentage of minus 200 mesh in the ore discharged from the first stage grinding equipment (for closed cycle ore grinding, calculated according to the overflow ore discharge from the classifier);

B₂ = Percentage of minus 200 mesh in the ore charged into the first stage grinding equipment;

$\sum AT$ = Sum of cubic meter-hours for all the grinding equipment of the plant, A being the volume of each unit of grinding machine and T the total "turning" (operating or running) time in hours (includes grinding machines for all stages and middling regrinding, tailing regrinding, and other grinding machines);

$\sum A_1 T_1$ = Sum of the cubic meter-hours for all grinding machines in the first stage.

Note: (1) All grinding machine volumes calculated according to effective volumes; the volume for ball mills is calculated on the basis of total volume (includes volume occupied by the steel balls).

(2) Ore handled by gravity mill is calculated on the basis of the part of the intake ores which meet specifications.

(3) For all tungsten gravity mills, calculations have been changed from the newly made minus 200 mesh production to newly made minus 1.5 mm production.

(4) Calculations by both the above methods are made once a month for all plants.

B. Calculations for Mill Recovery Rates:

1. Formula for calculating mill recovery rate in the case of a single mineral:

Actual recovery rate % =

$$\frac{\text{concentrate quantity (m.t. dry)} \times \text{concentrate grade}}{\text{mine-run ore quantity (m.t. dry)} \times \text{ore grade}} \times 100$$

Theoretical recovery rate % =

$$\frac{\text{concentrate grade} \times (\text{mine-run ore grade} - \text{tailings grade})}{\text{mine-run ore grade} \times (\text{concentrate grade} - \text{tailings grade})} \times 100$$

2. Formula for calculating theoretical mill recovery rates for two concentrate products:

We assume A to be the first type of concentrate product, and B to be the second type of concentrate product; and that a, b, c, and a₁, b₁, c₁ to be their metal contents (see tabulation below).

	Grade	
	A	B
Mine-run ore	a	b
First concentrate A	a ₁	b ₁
Second concentrate B	a ₂	b ₂
Tailings	a ₃	b ₃

Then the recovery rate in terms of the first concentrate A is:

$$R_A\% = \frac{a_1 \times [(a-a_2)(b_2-b_3) - (a_2-a_3)(b-b_2)]}{a \times [(a_1-a_2)(b_2-b_3) - (a_2-a_3)(b_1-b_2)]} \times 100$$

And the recovery rate for the second concentrate B is:

$$R_B\% = \frac{b_2 \times [(a_1-a)(b-b_3) - (a-a_3)(b_1-b)]}{b \times [(c_1-a_2)(b_2-b_3) - (a_2-a_3)(b_1-b_2)]}$$

3. Formula for calculating theoretical mill recovery rates for three concentrate products. We assume the metal contents for the various products are according to the tabulation below:

	Grade		
	A	B	C
Mine-run ore	a	b	c
First concentrate A	a ₁	b ₁	c ₁
Second concentrate B	a ₂	b ₂	c ₂
Third concentrate C	a ₃	b ₃	c ₃
Tailings	a ₄	b ₄	c ₄

Note:

(1) When calculating actual recovery rates, the mine-run ore part is based upon intake at mill. In the case of tungsten and tin gravity concentration when hand sorting is previously done, calculations are based upon the ore "coming out of the cage."

(2) When calculating the mill recovery rates, the grade of the concentrate should be based upon the final product leaving the plant or mill. When the mill only produces intermediate products or intermediate tailings, the mill recovery rates should only be calculated to the stage of intermediate tailings. If final products and intermediate tailings are produced, calculations should be based on an average.

(3) When the ore contains sulfur or iron which are simultaneously recovered, the recovery rates should be calculated on the basis of all the sulfur and iron.

(4) Mill recovery rates should be calculated during each shift. At month's end, average figures should be taken.

C. Calculated Indicators for Turning Rate of the Grinding Machine

1. The turning rate for the grinding machine should be based upon the actual time and solar calendar time (365 days a year). Formula as follows:

Turning rate % =

$$\frac{\text{Total turning time for grinding machine (hours)}}{\text{Total time on calendar basis (hours)}} \times 100$$

2. When the grinding operations are interrupted, the turning time during the period when intake ore is stopped but the grinding machine is still moving also should be included in the calculations. When actual operations are stopped, the stoppage time must be included no matter how long.

3. The turning rate for the plant as a whole should be the average for all the grinding machines (includes all grinding such as for middlings, concentrate, tailings, reground ore).

4. The turning rate for the grinding machines should be calculated once a month.

2. Carry Out Basic Construction of the Metallurgical Industry at a Rapid Pace

No 41, 16 October 1959
Pages 3-6 (full translation)

Editorial

In mid-September, the Ministry of Metallurgical Industry called the first experience exchange conference with regard to high speed and good quality of basic construction. The policy decisions, targets, and conclusions for the conference have already been reported. This meeting was very important, so we are describing it further.

Since the great leap forward of last year, we have made glorious achievements in the metallurgical industry basic construction front. We not only accomplished much work, constructed many enterprises, and developed many new techniques, but more important we have also been able to find means to make great savings in expenses in conducting basic construction at a rapid pace. Progress during the great leap forward cannot be compared with the past. Prior to the leap forward, because of lack of experience and inability to liberate thought, we encountered so many difficulties in metallurgical industry construction (from geological exploration to plant design, plant construction, and equipment installation) so that it took one, two, three, five, or more years to design a plant, carry out a project, or develop an enterprise. We did not dare to think as to how to reduce the time. We thought of a year as a unit of calculation. However, since the leap forward, as a result of constructive ideas from the masses, we were determined to double the rate of construction and cut expenses by half. There were many who felt that this could not be done. Subsequent results showed that the rate of construction did in fact double or even triplicate and investments for medium and small enterprises were cut in half and investments for large enterprises were cut by a third. Prior to the leap forward it took at least 9 months to build a 1,000-cubic meter blast furnace, whereas in the subsequent construction of the much bigger Anshan No. 10 blast furnace (last year) and Wuhan No. 2 blast furnace (this year), it took only a little more than 4 months. Similarly, the building of a large open hearth furnace formerly took 15 months compared with 3 months last year; the building of a large coke oven plant formerly took 22 months compared with the present 7 months (partly brought into production); the building of an 80,000-ton converter unit now requires only about 3 months; the building of a large rolling mill formerly took 20 months as compared with about 11 months now. After these records were established, people's opinions changed and they no longer felt that basic construction is so difficult a task; the construction time unit has been changed from "year" to "month" and "day". We feel that this change in concept not only expedites basic construction but also has great significance for the future. Our steel production is still so small for a population of 650,000,000 people, hence we must build many more metallurgical enterprises. Compared with distant goals, our accomplishments are so small. We must further accelerate basic construction for, in so doing, overall metallurgical progress will also be accelerated.

During a metallurgical conference called by the Ministry of Metallurgical Industry at Wuhan in mid-September, the successes of the great leap forward were reviewed and a rapid development policy conforming to the main line was decided upon. Simply stated, this policy is high speed, good quality, stress savings, and work together. We should explain this policy further. High speed and good quality really cannot be separated. For example, the blast furnace work at Wuhan and the engineering projects carried out at the Anshan and Shih-ching-shan steel centers were all both quickly done and done well. Conversely, the projects which moved slowly often developed quality bottlenecks. Many people are still not convinced that these two objectives can be successfully carried out simultaneously.

If the viewpoint that good work can only be done slowly prevails, then high speed construction will become impossible. We must therefore link the two concepts together to avoid excuses being made.

The emphasis on savings is vital to basic construction. Making savings means more extensive construction, and of course the more the construction the quicker the development. During the leap forward of last year, we found a very good method of making savings in expenditures through the "investment contract work system." The Shih-ching-shan Iron and Steel Company in using the system was able to make enough savings to construct a 1,200,000-ton iron and steel plant with the original funds provided for a 600,000-ton plant. Although this system is good, not all enterprises have accepted it; some criticize it from many angles, others misuse government funds because of the convenience of "investment contract work." In construction and installation work, there is also too much provincial thinking without giving due regard for saving money for the country. Since we have acquired very good experience as to how to make savings effectively, we should use this to overcome existing deficiencies.

The concept of working closely together was developed as a result of the special nature of basic construction. A metallurgical enterprise is built by many people and many units, from investigation and design units to construction, installation, and management units, each of which has its own sub-units. Any unit which does not do well affects the overall speed and quality of construction as well as the effective utilization of funds. Cooperating closely together is really a basic concept of communism. During the leap forward, unified leadership among central and local units had a very important effect on consolidating thinking and expediting construction. Some people still do not recognize the importance of this concept. As the scale and rate of construction become greater in the future, much losses would be sustained if participating groups do not work closely together.

During this conference on the exchange of experiences, it was concluded that the following ten types of experiences would be most helpful in carrying out rapid and good quality construction. (1) Strengthen Party direction. (2) Push the mass movement, and emphasize technical improvements. (3) Do good preparatory work prior to operations and plan for the adequate supply of materials and equipment. (4) Concentrate the best troops to win important battles, avoid dissipation of forces in holding the line. (5) According to the characteristics of the projects, organize shock troops to expedite operations. (6) Carry out the "vertical intersection parallel operations" method along the whole front. (7) As much as possible, emphasize pre-made or prefabricated parts and "pre-installation." (8) Combine "mass self-inspection and specialist inspection" and coordinate thought education on good work quality and strengthening of management systems to assure good overall work quality. (9) According to the characteristics of the projects, do well on the key technical points. (10) After construction work is completed, special care must be made in inspection and trial runs before the project is turned over. We hope that all construction units will benefit from these valuable experiences.

During this conference, we concluded that ten types of "advanced techniques" should be more widely applied: (1) pre-stressed concrete pipes, (2) pre-stressed structures, (3) quenched slag concrete, (4) heat resistant concrete, (5) water-prevention concrete, (6) fine sand concrete, (7) pressure-slurry filling method, (8) brick arch to suspend the beam for the hoist, (9) "friction" welding, (10) "dry sealing of electric cable ends." These techniques were developed by the masses during last year's great leap forward on the basis of thought liberation, they should be very important in expediting socialist construction, assuring good work quality, and making savings in expenditures. For a while, some people were pouring cold water on using certain techniques on a national scale. The consensus during the conference was that these techniques are worthy of wider use. Of course, new techniques do not end here. We must continue to overcome superstitions, liberate thought, and develop new techniques to further raise the technical levels of design, construction, and equipment installation.

The reason we are reviewing the experiences of last year's great leap forward is to find the best way to move ahead in metallurgical construction. During the last quarter of this year we must do our utmost in basic construction so as to assure the completion and bringing into production of 200-odd projects (which in turn will help us surpass the targets in ferrous and nonferrous metals) and, at the same time, prepare the ground work for a further great leap forward next year. The present operating conditions in the metallurgical industry are very good and output of various products is steadily rising; but for us to overfulfill targets it will still be necessary to rely on new facilities brought into production. The 200-odd projects to be brought into production in the fourth quarter will provide an output this year of 470,000 metric tons of pig iron, 360,000 tons of steel, 230,000 tons of steel materials, 5,000 tons of aluminum, and 5,000 tons of copper. Since the meeting was concluded on 19 September, we have but 100 days to achieve the above additional output. We must also prepare important projects for next year's leap forward, especially those that will be brought into production during the first and second quarters.

During the previous period, rightist thinking showed up in various degrees. However, as a result of Central Government directives and mass support, this problem has essentially been solved. The rate of progress in basic construction has now been accelerated. Experience tells us that rightist thinking was a natural stage in the chain of events. This thinking was exemplified in the following ways: (1) slowed down operations for work quality considerations, (2) did not believe that speed can be doubled and investments cut in half, (3) poured cold water on new techniques, (4) criticized the weak points in design while ignoring the benefits of revolutionizing design, (5) did not believe in the "investment contract work" system, (6) thought little of building strength from within and making construction materials like cement by native methods, (7) did not promote native machinery and small and simple tools, and (8) thought little of the revolutionary changes in the basic construction systems. Rightist thinking along these lines caused some places not to start the mass movement, to forget about the technical revolution, and to fail to emphasize dare-to-think, dare-to-say, and dare-to-do. Fear of failure and indifference are

the reasons why some projects were not successful. We must learn from the mistakes of rightist thinking in planning for further great progress in the future. Once rightist thinking is entirely eliminated, the work spirit will rise and greater success will be achieved in the metallurgical industry basic construction front.

Comrades in the metallurgical industry basic construction front, let us raise high the banner of the main line and take great strides forward in the rapid development of our country's metallurgical industry.

3. Ensure the Early Operation of the More Than 200 Projects by Raising Work Enthusiasm

No 41, 16 October 1959
Pages 8-10 (full translation)

Unsigned article

Through the operation policy of high speed, good quality, economy, and close cooperation, work particularly hard for 100 days, to ensure more than 200 projects being brought into production to provide a new force to fulfill or surpass the steel target of 12,000,000 metric tons. This is the objective of the basic construction experience exchange conference recently called by the Ministry of the Metallurgical Industry. The meeting was held at the Wuhan Iron and Steel Company facilities which repeatedly established new operational records of high speed and good quality. More than 100 enterprises and design units participated in the conference.

The more than 300 persons attending the conference reviewed the glorious achievements in basic construction of metallurgical enterprises during the great leap forward of 1958. They drew conclusions from the experiences of the various enterprises and pointed out that (1) construction of large scale blast furnaces took 4-5 months as compared with the past one year or more; (2) construction of large rolling mills took 11 months as compared with the past 18 months or more; (3) construction of large sintering plants took 5-6 months as compared with the past 18 months or more; (4) construction of large coke projects (brick work) took about 30 days compared with the past 60 days; and (5) construction of large open hearth furnaces took 3 months compared with the past 6 months. Such an acceleration has great significance, for it not only accomplished the slogan of the masses to cut construction time in half but it also created a revolutionary concept in metallurgical basic construction. Since these records were established, people involved in programming basic construction no longer thought about a "year" as the time unit but rather "months" and "days."

The conferees concluded that high speed and good quality could simultaneously attained and that accomplishing one at the expense of the other is a wrong concept. The following ten types of experiences were concluded to be most helpful in carrying out rapid and good quality construction: (1) Strengthen Party direction; (2) push the mass movement, and emphasize technical improvements; (3) do good preparatory work prior to operations and plan for the adequate supply of materials and equipment; (4) concentrate

the best troops to win important battles, avoid dissipation of forces in holding the line; (5) according to the characteristics of the projects, organize shock troops to expedite operations; (6) carry out the "vertical intersection parallel operations" method along the whole front; (7) as much as possible, emphasize pre-made or pre-fabricated parts and "pre-installation"; (8) combine "mass self-inspection and specialist inspection" and coordinate thought education on good work quality and strengthening of management systems to assure good overall work quality; (9) according to the characteristics of the projects, do well on the key technical points; and (10) after construction work is completed, special care must be made in inspection and trial runs before projects are turned over. The conference passed eight resolutions on technical management systems and five resolutions on the important points regarding five key types of projects (foundations, concrete, engineering structure, furnace construction, and welding and "connecting").

According to the experiences of some enterprises on the "investment contract work" system, it was concluded that economy along the whole front was essential to make the best use of available funds and economic indices of construction must be seriously considered. The system should be most effective and can save the country much money. Various units attending the conference all established economy and materials indices for steel, cement, and lumber, etc.

The conference concluded that close cooperation by various units in the spirit of communism is basic to rapid construction and contract work delegated to various units and manpower, equipment, and materials problems must be handled in terms of mutual cooperation. At the conference, the units discussed matters as to how to regulate, assign, and help each other in equipment, materials, and manpower with the view to expediting construction.

The conference drew conclusions as to the results of last year's technical revolution. It was pointed out that thought liberation and overcoming superstitions are very significant in improving techniques. Last year's ten most successful techniques should be put to widespread use. These are: pre-stressed concrete pipes; pre-stressed structures; quenched slag concrete; heat resistant concrete; water-prevention concrete; fine sand concrete; pressure slurry filling method; brick arch to suspend the beam for the hoist; "friction" welding; and "dry sealing of electric cable ends."

The conference reviewed the experience of basic construction units which employed the native-modern combination method and self-making of machinery and tools during the last year. It was concluded that building strength from within should be a long-term policy for native-modern operations in furnishing equipment, tools, and installation and construction personnel.

In reviewing the metallurgical industry's magnificent achievements in basic construction since the beginning of the leap forward, the conferees also examined the detrimental effect of rightist thinking. Representatives of the more than 100 units attending, with a spirit of combating rightist thinking and determined to work particularly hard, clearly see the way for

moving ahead with great confidence, enthusiasm and ambition. They support political direction, the mass movement, and the spirit of cooperation in communism. They wish to compete in gaining strength from within, in methods to overcome difficulties, in completion of work schedule, in absolute time of construction, in work quality, in economy, in productivity, in adoption of new techniques, in building of machinery, and in safety. Thirteen contest contracts were signed in a friendly manner. A review of the contests will be made once a month. Everything is done to make sure that the 200-odd projects will be brought into production on schedule or ahead of schedule.

The Ministry of Metallurgical Industry awarded victory banners to 9 units for their outstanding work during the leap forward. Six of the 9 units are: Wuhan Iron and Steel Company; the Chiu-ch'uan Iron and Steel Company, An-kang Engineering Office; the Pao-t'ou Iron and Steel Company; the Shih-ching-shan Iron and Steel Company; the Hsiang-t'an Iron and Steel Company; and the Hsi-pei Metallurgical Construction Main Company.

4. Terms of Contests Among Metallurgical Industry Construction Units

No 41, 16 October 1959
Pages 10-13 (full translation)

Unsigned article

To fulfill or surpass this year's steel target of 12,000,000 metric tons, the units represented at the experience exchange conference pertaining to rapid and good quality basic construction in the metallurgical industry developed the "ten compare" contest to assure the bringing into production of more than 200 projects assigned to be completed this year. All of the 93 units attending the conference pledged to participate in the contest, and during the conference 13 contest contracts were signed. The units participating in the various contests were divided into groups, as follows:

- Group one -- Wuhan, Pao-t'ou, and Anshan Iron and Steel Companies.
- Group two -- Shih-ching-shan, Hsiang-t'an, T'aiyuan, Chungking, Lung-yen, and Ma-an-shan Iron and Steel Companies.
- Group three -- Pen-ch'i Iron and Steel Company, Dairen Steel Plant, and Ta-yeh Steel Plant.
- Group four -- The five provinces of Hopeh, Szechwan, Honan, Anhwei, and Shantung.
- Group five -- The six provinces of Kiangsu, Chekiang, Hupeh, Hunan, Fukien, and Kiangsi.
- Group six -- The four provinces and cities of Heilungkiang, Kirin, Liaoning, and Peiping.
- Group seven -- The four provinces and autonomous regions of Yunnan, Kweichow, Kwangsi, and Kwangtung.
- Group eight -- The five provinces and autonomous regions of Shensi, Kansu, Tsinghai, Sinkiang, and Ningsia.

We are describing below the general contest conditions for Wuhan, Pao-t'ou, Shih-ching-shan steel companies and the Shantung Metallurgical Bureau.

Wuhan Iron and Steel Company

1. According to the Ministry's assigned dates, complete 10-15 days ahead of schedule the Nos. 1, 2, and 3 batteries of flotation cells of the ore dressing plant, the Nos. 2, 3, and 4 sintering machines of the sintering plant, the Nos. 1 and 2 open hearth furnaces of the steel plant, the No. 4 coke ovens for the coke plant, and one other project.

2. Work period indices:

- a. Blooming mill to be brought into production in 10 months.
- b. 4,250 steam blowers to be brought into production in two months.
- c. Nos. 3 and 4 sintering machines to be completed in two months.
- d. 500-ton open hearth furnace to be completed in 80 days.
- e. No. 3 large size blast furnace (1513 cubic meters) to be completed in 4 months.
- f. No. 4 large size coke ovens (65 openings or slots) to be completed in five months.

3. Assure good work quality: eliminate inadequate strength in concrete, not meeting specifications in welding and connecting, uneven sinking of foundations, and underground water leakage incidents, and reduce general accidents or incidents related to work quality. Strive to rank first in work quality among metallurgical industry basic construction units and turn over a well done job to the country.

4. Raise work productivity: make sure that new workmen will generally attain the "No. 3 level of skill" this year, that work attendance will reach 96-97%, and that the completion of heavy equipment will be stabilized at 96%, cars or vehicles at 90%, and machinery utilization at 76%; raise overall productivity by 20%.

5. Tighten scientific research work and push the following eight new techniques:

- a. Integrated utilization of mine slag, make expanding mine slag, produce light weight concrete walls, use hot cast mine slag blocks to substitute for cast iron, utilize quenched slag to produce sulfate cement, use (slag) as mixture in cement, and widely employ heavy mine slag as constituent for making heat resistant and common concrete.
- b. Use of water-prevention concrete to substitute for steel plates in guarding against water.
- c. Use of \varnothing 800 mm and \varnothing 1,000 mm pre-stressed pipes to substitute for cast iron pipes.
- d. Widely employ dirt-filling foundations for deep foundations.
- e. Push the use of heavy mine slag heat resistant concrete.
- f. Push the use of "friction" welding and the new technique of dry sealing of cables.
- g. Push the use of electric slag welding.
- h. Push the use of electric heat expansion method to produce pre-stressed beams for hoists.

6. Reduce engineering costs, create strength from within, and economize on materials:

- a. Attain cost reduction of 15% for the year.
- b. By the end of this year, assure self-made cement production of 40,000 metric tons and strive for 50,000 tons.
- c. Make sure that for the fourth quarter of this year the "economizing indices" for the four main raw materials will be as follows: steel materials 6%, cement 20%, lumber 20%, and refractory materials 6%.

7. Strive for no bad accidents for the remainder of the year and reduce the number of ordinary accidents so as to achieve safe operations.

Pao-t'ou Iron and Steel Company

1. Ensure fulfillment or overfulfillment of this year's investment targets.

2. Complete on or ahead of schedule the projects assigned:

- a. Make sure that pig iron production from the No. 1 blast furnace for the remainder of the year (since September when furnace operations started) be 150,000 metric tons or greater.
- b. Make sure that steel ingot production from the 10-ton electric furnace for the remainder of the year (since September when furnace operations started) be 4,000 tons or greater.
- c. Make sure that coke production from the No. 2 coke ovens (65 slots) for the remainder of the year (since October when ovens brought into production) be at least 90,000 tons.

3. Aside from completing projects assigned by the Ministry, add the three projects of 300-500 [no unit given] small rolling mill, 76 seamless tube rolling mill, and nonferrous laboratory, to be respectively completed in October, November, and before the end of the year and brought into production.

4. Carry out a determined policy of rapid good quality construction:

- a. Construction time for the No. 1 large scale blast furnace to be equal or less than that for Wuhan.
- b. Construction time for the No. 2 large scale blast furnace to be equal or less than that for Anshan; assure bringing this furnace into production in less than 110 days.
- c. Construction time for the No. 2 65-slot large scale coke plant to be equal or less than that for Wuhan.
- d. Construction time for the No. 3 65-slot coke plant to be six months or less.
- e. Construction time for the brick work of the large coke oven plants to be 33 days or less; we will strive for the new national record of 28 days.
- f. Construction time for the blooming mill to catch Taiyuan and surpass Wuhan, assuring the bringing into production in 10 months.

5. Determine to successfully combat rightist thinking, overcome superstitions, liberate thinking, push the technical revolution, and widely employ new techniques. Assure the wide application of the following eight main techniques during the fourth quarter:

- a. Pressure pouring of slurry for concrete -- 10,000 cubic meters.
 - b. Pre-stressed concrete structures -- 10,000 cubic meters.
 - c. Quenched slag concrete -- 1,000 cubic meters.
 - d. Water-prevention concrete -- 5,000 cubic meters.
 - e. Bitumen slurry for water prevention -- 3,000 square meters.
 - f. 25-meter or deeper shaft for dewatering.
 - g. Successful construction of 55-cubic meter hot air furnace with heat resistant concrete.
 - h. Will make repeated tests on pre-stressed pipes so that 1.4-meter pipes of this type reach technical specifications.
6. While pushing the mass movement, rapid construction, and the technical revolution movement so as to attain the twin goals of high speed and good quality, eliminate fatal injuries and reduce ordinary accidents.
7. Carry out the policy of economy, especially with regard to construction materials:
- a. Reduce cost by 5%.
 - b. Save 10% in steel materials, 15% in cement, and 20% in lumber.
 - c. Equipment completion rate to reach 90% or greater, and their utilization rate, 75% or better.
 - d. Implement the "two-legged" policy, coordinate mechanized and semi-mechanized operations, simultaneously use modern with native, create strength from within, and make by ourselves 2,000-odd units of small scale mechanical implements and tools.

Shih-ching-shan Iron and Steel Company

- 1. "Contesting for a high rate of finished products": aside from the projects assigned by the Ministry for completion, install additionally a cold drawn steel pipe plant, an oxygen-making unit, a limestone mine, a bitumen coke furnace, and "an electrical repair plant," etc., all to be brought into operations within the a? year.
- 2. Contesting for rapid construction:
 - a. Electrically welded pipe plant to be completed in 6 months.
 - b. "Ch'ien-luan mine plant" electricity distribution cables and railroad project to be completed 30 days ahead of schedule.
 - c. Cold drawn steel pipe plant to be completed in 4 months.
 - d. Oxygen-manufacture unit to be installed in 4 months.
 - e. Small scale rolling plant to be completed in 7 months.
 - f. Complete 15 days ahead of schedule the "after new investments" 1959 leap forward targets.
- 3. Hold contests for work quality: on the foundation of eliminating serious incidents and reducing ordinary incidents, assure the completion of all projects in good shape before turning them over to the state.
- 4. Hold contests for economy in investments: on the foundation of "investment contract work, one plant turn into two plants," further reduce costs by 8%.
- 5. Hold contests for safe operations: while assuring rapid construction, eliminate serious injury and fatal incidents.

Shantung Metallurgical Bureau

1. Assure completion 10 days ahead of schedule a 100-cubic meter blast furnace, four 6-ton convertors, a 500/300 rolling mill, two small aluminum plants, etc.
2. Within this year, additionally construct four 55-meter blast furnaces, rehabilitate and newly construct a total of 1,500-2,000 cubic meter capacity of 3-28 cubic meter size blast furnaces, two 6-ton convertors, a unit each of 500/300 and 320/250 rolling mills, a 76 mm seamless tube mill, and a 950 mm thin plate rolling mill.
3. Assure fulfillment or overfulfillment of all basic construction and output quota assignments made by the Ministry. Complete capacity of 20,000 metric tons of pig iron (Ministry quota 10,600 tons), 6,500 tons of steel (Ministry quota of 6,000 tons), 4,000 tons of steel materials (Ministry quota of 3,800 tons), and 200 tons of aluminum (Ministry quota of 180 tons).
4. Assure good work quality and safety: all projects to meet specifications when turned over for production; serious incidents to be eliminated and ordinary accidents reduced.
5. With regard to cost reductions assigned for the Province, reduce the assigned 3% by another 2%.
6. Raise productivity: we require productivity for native construction workmen to be raised 30% above that achieved in January-August; and for installation workmen, 15%.

5. A Plant in the Northwest

No 41, 16 October 1959
Pages 30-31 (extracts)

Northwest Metallurgical Construction Main Company

A certain plant in the northwest is a foreign designed modern integrated enterprise. The buildings are distributed in an area 43 kilometers long. The total plant area is 170,118 square meters. The main structure is 31,160 square meters in area, 37 meters high, and 12 meters deep in foundations; it has 6 parts. One structure is 41 meters high, with 11 layers of steel reinforced concrete. There is a 120-meter high chimney, and a 28-kilometer water supply pipe. The total length of underground pipe passageways is 247.7 kilometers, which house heating pipes, electric cables, etc.

We had no experience in constructing such a large, modern and complicated combination enterprise. Yet under the leadership of the Party with emphasis on political guidance, pushing the mass movement, and developing the communist spirit of "dare-to-think, dare-to-say, and dare-to-do," not only have the construction and installation quotas been fulfilled but work has been done at a rapid pace. In building the main structure, the original time assigned was 19 months (modified to 13 months during the leap forward) but it only took 5 months to complete the whole native construction project. One unit assigned to be built in 6 months was completed in 65 days. In

installing 3 units of D-20 boilers, the assigned man-days was 12,000, compared with the actual completion man-days of 4,560 during last year's leap forward; the work was not only rapid but good quality. The projects in this plant region, through hard work by the masses, were completed in a year's time compared with the three years programmed. As a result of developing new techniques during the leap forward and creating strength from within in producing construction materials, costs have been reduced by 9.2%.

6. Hunan Metallurgical Plants

No 41, 16 October 1959
Pages 33-34 (extracts)

Chao Ch'ao-shan,
Deputy Director,
Hunan Metallurgical Bureau

Since the Party's Eighth Plenary Session, basic construction in Hunan Province metallurgical industries has assumed a new complexion. The masses have been working particularly hard, productivity has been greatly raised, and basic construction has been moving ahead according to schedule. The work done in August, measured in terms of value, was 1,500,000 plus yuan more than in July. During August, the 601 Plant completed 13 projects, whereas in April-July not a single project supposed to have been brought into production was turned over. With regard to construction of simple coke ovens in the Heng-yang Special District, work was slow in the beginning but, after the Eighth Plenary Session and as a result of combating rightist thinking, the assigned projects were quickly finished.

Basic construction in Hunan metallurgical industries made great progress during 1958. Construction investments completed in this year was 60% greater than for the whole First Five-Year Plan period. Many records were established in high speed construction. For 7-8 story high plant structure, it took only $2\frac{1}{2}$ days to build a story. One of T'ao-lin lead zinc mine's ore dressing plants required only 4 months to construct. Accelerated basic construction promoted the expansion of the province's iron and steel industry. Before the Liberation, Hunan had had only one small iron plant, capable of producing 1,000 tons yearly. In 1957, the pig iron capacity was raised 90,000 metric tons per annum and 15 mines were established. The rate of progress in 1958 was even quicker. In this year, pig iron capacity was increased by 500,000-odd tons, the number of mines was raised to above 70, and the number of staff and workers was raised to 150,000. In the past, there was virtually no iron and steel industry in Hunan; now, the province has 4 steel plants and one integrated iron and steel enterprise.

During the three months after this year, 5 additional important items will be brought into production.

7. Battle for More and Better Ores

No 41, 16 October 1959
Pages 35-36 (extracts)

Editorial

To carry out Party and Central Government directives pertaining to completing the Second Five-Year Plan (1962) targets this year, to assure the supply of various ores for this year's leap forward iron and steel production, and to prepare the ground work for continued leap forward in iron and steel production next year, the mines producing ferrous ores must in the next three months produce even more ore. For iron ore, aside from meeting quotas, it is necessary to produce 24.5% more, and for manganese ore, aside from meeting quotas, it is necessary to produce an additional 15%. The principal iron mines in the country must hereon during each month develop (strip overburden and dig underground passageways) 18% more ore than that developed in July and, by year's end, should have a three month's supply of retreat mining ore. By the end of the year, the medium and small iron mines should have 1-2 month's supply of retreat mining ore. Quality of various ores should be raised 1-3% above the originally assigned grade. The unit production cost should be 3-10% below that originally planned. The work efficiency in extraction and development should be 20-50% better than that attained during the first half of the year so as to achieve the objective of increasing production without increasing manpower. The mining intensity should be raised 10-20% above the July levels. The utilization rate for the major equipment should be raised 5-20% above the July levels. At the same time, safe production must be achieved and major accidents eliminated. These standards were suggested and unanimously agreed upon by representatives attending the National Ferrous Mines Conference held at the P'ang-chia-pu Iron Mine of the Lung-yen Iron and Steel Company and organized by the Ministry of Metallurgical Industry and the Heavy Industry Labor Union. These are also the guide lines for the mining army of several hundreds of thousands to work toward in the next three months.

The fourth quarter objectives for the ferrous mines are both glorious and difficult to achieve. To attain these high production indices, monthly production for the remaining months of this year must average 21% greater than the August level. We feel we can accomplish these objectives and even surpass them, because of favorable circumstances. During January to August, iron ore production had already reached 80.5% of the whole year's planned target; and during January to July, manganese ore production had already reached 60% of the whole year's planned target. Output increases are nearly two times greater than during similar periods of last year. Comparing the production for the last ten days of August with the production for the first ten days of August, iron ore output for the major mines rose by 25%, iron concentrate fines for the country rose by 16.5%, and manganese ore output for the major mines rose by 1.6 times. From another viewpoint, after 7 months of strenuous effort, many production systems and regulations have been established in industrial management and the rich experiences of the leap forward year have been carefully reviewed for future application, so

that overall organization has been strengthened. From the viewpoint of technical manpower, the mining army of several hundred thousand, after a year of training and "tempering" have attained much higher levels of technical proficiency. Overall mechanization in ore extraction has also been greatly improved, as a result of the mass type technical revolution and improvement in mining equipment and implements. For these reasons, productivity has in general been raised one to two times.

8. Must Provide Enough Ferrous Ores for the Furnaces

No 41, 16 October 1959
Pages 38-39 (extracts)

Unsigned article

Since the beginning of this year, the army of several hundred thousand battling in the ferrous ore mine production front have scored great successes under the reflection of the main line. During the first 8 months, output of iron ore had already reached 80.5% of the whole year's quota or about two times greater than the production for the corresponding period last year. The local small and medium mines have done particularly well. In 8 months, they have already fulfilled the 1959 quota and actual output was about 7 times greater than the output for the corresponding period last year. Production of iron concentrate in the first 8 months reached 61% of the whole year's target figure, or 92.5% of all of last year's output. During the first 7 months of this year, production of manganese ore attained 54% of the year's target, or more than two times greater than the production in the corresponding period last year. During the first 7 months of this year, clay production was equivalent to 66.6% of the year's target. Output of magnesite, dolomite, silica, and limestone are all exceeding quotas and much above last year's levels. As for product quality iron ores are generally 1-3% greater in iron content than assigned specifications and the grade of iron concentrate fines has reached 63-65% Fe. Technical and economic indices have been greatly raised, mining intensity is generally 5-20% higher than last year (for the Chin-ling and Chi-chiang iron mines, the increase reached as much as 2), and electric shovel efficiency and drilling machine efficiency have all been raised 10-30%. Achievements so far give assurance that this year's iron and steel production will more than meet planned targets. The continued leap forward in iron and steel production means that there must be a corresponding leap forward in the production of ferrous ores. During the coming fourth quarter, aside from fulfilling quotas in terms of quantity, it is also necessary to raise the output of good quality ores by more than 20%.

9. Mobilization of the Mines for Big Contests

No 41, 16 October 1959
Pages 40-42 (extracts)

Unsigned article

A great wave of contests and cooperation has been developed in the ferrous mines of the country. The 21 mines participating in the National Ferrous Mines Conference have signed contest agreements according to the following categories: large opencut mines, medium opencut mines, underground mines, and manganese mines.

The An-kang, Tung-an-shan (in the Anshan area), and four other large scale opencut iron mines have pledged to compete in operations to more fully utilize modern equipment and create favorable stripping conditions. They intend to produce more than 10 million metric tons of iron ore during the last few months of this year to help achieve the 1962 (Second Five-Year Plan) iron and steel production targets three years ahead of schedule. After careful calculations with regard to new measures to uncover latent potential in production and based upon different conditions of the various mines, they came up with the following competition standards:

Tung-an-shan Iron Mine -- 320,000 metric tons of ore output above assigned quota; grade, 34% or better; cost reduction, 500,000 yuan for the whole year; efficiency of equipment above July levels in percent -- electric shovels 20%, drilling machine 10%, electric locomotives 5%; eliminate serious and fatal accidents and reduce light accidents 20% below the rate during the first half year; develop more than 3 months supply of retreat mining ore by year's end.

Ta-yeh Iron Mine -- achieve 15 days ahead of schedule the whole year's quota; grade, 97 $\frac{1}{2}$; cost reduction, 5% below plan; efficiency of equipment above July levels -- electric locomotives 25%; eliminate serious accidents and reduce light accidents 50% below the rate during the first half year; ore ready for extraction, 10 months supply.

Pai-yun-ao-po Mine -- 300,000 tons of iron ore above assigned quota; grade, 49% or better; cost reduction, 5% below plan; efficiency of equipment above July levels -- electric shovel, 20%; eliminate serious accidents and reduce light accidents by 50%.

Ta-hu-shan Iron Mine -- 300,000 metric tons above assigned quota; monthly advance of electric shovel, 100 meters; retreat mining ore by year's end, more than 5 months supply.

Nan-fen Iron Mine -- 50,000 tons above assigned quota; equipment efficiency above July levels -- electric shovel 15%, drilling machine 10%, trucks 15%; eliminate fatal accidents; retreat mining ore, 2 months supply or more by year's end.

Underground iron mines also want to ensure overfulfillment of production quotas for this year. The mines belonging to the Lung-yen Iron and Steel Company have issued a challenge to the Hsiang-t'an Manganese Mine to produce 100,000-130,000 metric tons above the year's quota, raise extraction or mining intensity 20% above the July level, and better ore quality for the P'ang-chia-p'u Mine, to 50% Fe plus. The Ch'a-hua-miao Iron Mine in Hunan

Province, built quickly during the steel drive of last year, also wants to compete with the "big brother" mines. Within a little over a year since it was established and employing modern-native operations, Ch'a-hua-miao's output and product quality have been steadily raised and May production was 83% above that of April with additional increases thereafter. During the conference, representatives of this mine indicated they had much to learn from the "big brother" mines but at the same time were convinced that the mine would overfulfill the year's quota by 20% a month ahead of schedule; measures are to be implemented with a view to raising mine development efficiency and retreat mining efficiency respectively by 29.5% and 56% above the levels in the first half year. The Chi-chiang Iron Mine in Szechwan Province, which used the "one face many wide entry" mining method to increase mining intensity by more than two times, also is participating in the contests; this mine intends to further improve on its operations, meet all quotas, and prepare more than a year's supply of retreat mining ore.

Five medium small opencut iron mines, including the Chin-ling Mine in Shantung Province, have signed agreements for friendly contests as follows:

Chin-ling Iron Mine -- 30,000 metric tons above assigned ore production quota; grade, 58% for lump and 52% for fines; cost reduction, 10% below plan; equipment efficiency above August levels--electric shovel 20%, drilling machine 10%; eliminate serious injuries.

Li-kuo Iron Mine -- 109,000 tons above assigned production quota; grade, 2% (Fe) above plan; cost reduction, 7% below plan; eliminate serious injuries, reduce light injuries by 30% as compared with same period last year; strip 4,700,000 cubic meters of overburden for the year.

Ta-shih-chiao Magnesite Mine -- 65,000 tons above assigned production quota; grade, magnesite 92% and dolomite 100%; cost reduction, 10% below plan; equipment efficiency above August level--electric shovel 10%, drilling machine 10%, electric locomotive 150 tons per unit shift; eliminate serious injuries, reduce light injuries by 30%; prepare 3 months supply of retreat mining ore at year's end.

Feng-huang-shan Iron Mine -- 50,000 tons above assigned production quota; cost reduction, 40% less than actual for last year; eliminate serious injuries and reduce light injuries by 40% compared with the similar period last year; strip 810,000 cubic meters of overburden for the year.

Ma-an-shan Nan-shan Iron Mine -- 150,000 tons above assigned production quota; grade, raise 2% (Fe) above plan; reduce cost by 12% below plan; equipment efficiency above August levels--electric shovel 8%, drilling machine 10%; at year's end a 5-month supply of retreat mining ore, an 8-month supply of extraction prepared ore, and a 16-month supply of developed ore.

Representatives of manganese mines also joined in the contests. The spirit of some representatives of manganese mines from Nan-chiang and Kwangsi is wonderful; they not only pledged fulfillment of quota but an increase of output of 140,000 metric tons as well as cost reductions of 10-20%.

Representatives of various provincial and city bureaus also pledged overfulfillment of targets. Production in Szechwan Province during the

first 3 months of this year increased greatly, and plans have been made to surpass the whole year's quota by 3,300,000 metric tons (equivalent to 43% of the province's original quota); iron content will be raised by 2% (Fe) over the original plan; mining preparatory work will be pushed and the various mines in the province will have 3 months to a year supply of retreat mining ore; cost will be reduced by 10%.

10. Indices for Small Coke Ovens Approaching
Large Coke Ovens

No 42, 23 October 1959
Pages 38-39 (extracts)

Unsigned article

The Shih-chia-chuang Tung-li (motive power) Plant Coke Manufacturing Sub-plant's two groups of "Red Flag No. 2" coke ovens have been operating normally ever since being placed in production in the last ten days of April this year; no mechanical or "human" incidents have developed and output and product quality have steadily improved. In the beginning, each group of "Red Flag No. 2" coke ovens required 150 workers and produced 43.2 metric tons of coke per day; later, manpower was reduced to 119 workers and daily output raised to 61.4 tons per day or 33.4% above the highest designed capacity. Technical and economic indices have also been steadily improved. Coking time has been reduced from 20 hours to 14 hours and the hope is to reduce the time further to 13.3 hours; the coke forming efficiency is now 78.4% with the relatively low volatile coal used and the actual efficiency has reached 82%; quality of coke has also improved, ash being reduced from 16.4% to 13.5% and sulfur, 0.69% to 0.5%; "intensity" has been raised from 290 kilograms to 339 kilograms; and cost has been reduced from 48.6 yuan to 40 yuan. These indices are much better than ordinary native coke ovens and are approaching the indices for large coke ovens.

To improve the quality of washed coal, we used more water, lengthened the water troughs, sorted out large pieces of waste rock, and did careful analysis work. As a result, the ash content of the cleaned or washed coal has been reduced from 12.5% to less than 10% (best, 8.1%); the coal in the waste water has been reduced from more than 10% to 8% (best, 5%); and sulfur content has been reduced from 0.6% to 0.5%. Meanwhile, coal washing efficiency has been more than doubled, coal washing workers has been reduced from 75 to 50 per shift, and production has been raised from 220 metric tons per shift to 350 tons.

Since many by-products can be recovered from coke ovens, our plant established two distilling units. Each day 4 metric tons of coal tar can be recovered, which is separated into heavy, medium, and light oils plus coke pitch, etc. Benzene towers are being built, and one has been brought into production. If benzene towers are installed on all four coke ovens, then 600 kilograms of crude benzene can be produced daily (calculated at 550 yuan, each month's overall output value can be raised 9,875 yuan).

The technical and economic indices for the "Red Flag No. 2" coke ovens at the Shih-chia-chuang Tung-li Coke Manufacturing Sub-plant are much better than those for native coke ovens at the same location.

<u>Item</u>	<u>"Red Flag No. 2" Ovens</u>	<u>Native Ovens</u>
Quality (ash content)	13.5%	15.5%
Coking time (cycle)	15 hours	200 hours
Coking efficiency	82%	68%
Cost	40 yuan*	47 yuan

* Can recover 2 tons of coal tar per day and produce 216 tons of crude benzene, which together mean an additional yearly income of 563,000 yuan.

11. Rational Technical Improvements on Simple Coke Ovens

No 42, 23 October 1959
Pages 40-42 (full translation)

Unsigned article

Editor's note -- the "Red Flag No. 2" simple coke oven has performed very well in actual production. To make it perform even better, technicians in various areas have made further modifications according to operational experience. We have selected a few techniques to be introduced below. These technical changes are all simple, inexpensive, and effective. They can be adopted according to local conditions.

The "coke grabbing structure" (for unloading coke, see Figure 1 in Figure Appendix) can unload coke quickly and safely. Coke production is a high-temperature operation. In simple ovens where manpower is used to "grab the coke," work conditions are difficult so that not only is production affected but also the workers' health; this is an often occurring difficulty in coke production. During the technical revolution movement, the Honan Province Hsu-ch'ang Coking Plant, the Hopeh Province Shih-chia-chuang Tung-li (motive power) Sub-plant, and others developed the simple and effective "coke grabbing structure" for unloading coke, which has many advantages and is worthy of wider use.

The construction of this "coke grabbing structure" is very simple, and it can be made with useless old materials, such as iron pipes, asbestos boards, and wooden boards attached to cast iron wheels for moving it around (see Figure 1 in Figure Appendix). Before this piece of equipment is used, first take away the oven door bricks and scrape off the coke scum, then push the "structure" to a position in front of the carbonization chamber at a distance of about 800 mm; use "single hook" to loosen the coke blocks, "double or multiple hook" to scrape out the coke, and then iron shovels to lift the coke to the "coke platform slope" for fire to die out. When scraping the coke, either a movable blower installed on top of the "coke platform" or a fixed blower in a nearby location can be used to improve working conditions.

After using the "coke grabbing structure", the radiation heat from the carbonization chamber is stopped by the heat insulation board and the coke scraping hook can be held or balanced on the structure; in this manner working conditions (load and heat) are greatly improved and one or two men can be saved per shift. When coke is unloaded, the area of brick at the opening can be reduced by one-third and the time for making and closing the the opening can be reduced.

The use of an electric elevator in loading coal is both a fast and work-saving measure -- The Shih-chia-chuang Tung-li Coke Manufacturing Sub-plant, during the technical revolution and according to the principle of charging in small blast furnaces, designed and made by itself a vertical type coal loading electric elevator, which not only raised productivity but also basically solved the serious problem of "high labor intensity."

The vertical type wooden bucket elevating machine has a square frame of 8-meter height, within which is a square cage in which is placed movable wooden bucket cars; the cage can be moved up and down through fly wheel (pulley) and cable connections. The frame of the machine is made of angle iron; on top of each coke oven is installed 7-kilogram-per-meter rails. Small cars with coal are pushed manually to the elevating machine and the coal is loaded into the wooden bucket cars, which are in turn raised to the top of the ovens. Coal loading workers move the wooden cars to the ovens which are to be charged. The discharge opening of the wooden cars are connected tightly to the intake openings of the coke ovens so that the coal drops cleanly into the ovens; each car of coal can be charged into the furnace in 1.15 minutes and two such carloads are needed to fill an oven slot. The use of the coal loading elevating machine has meant a manpower saving of one-third, improvement in working conditions, elimination of the past practice of manual carrying of coal up a 45-degree slope, doing away with the danger of bamboo baskets burning, reduction of loading time by 50%, better control of oven temperature, and higher production of coke. For this elevating machine, see Figure 2 in Figure Appendix.

Use of drying pit so that the coke oven "eats dry feed" -- Results have been very good in the use of the drying pit to dry the washed coal before loading into the coke oven. The Shih-chia-chuang Tung-li Plant Coking Sub-plant has installed the coal drying pit near the chimney where the coke is scraped out. The drying pit is built with refractory brick combined with ordinary brick; on top is placed 16 pieces of cast iron plate with an effective area of 8 square meters. A part of the coke oven waste gas is used to heat the drying pit, in which the inside temperature is kept at about 600-800°F and the pit surface temperature at about 300°F; 150 kilograms of washed coal per load (contains 7-8% water) is placed in pit to dry for about six minutes and when the coal reaches about 80° it can be pushed aside to dry. Practice has shown that when washed coal is dried not only is there no lowering of quality but there are also many advantages as follows:

1. Only three workmen are needed per shift in reducing the water content of 12.5 metric tons of coal from 7-8% to 2-3%, which is enough to load one furnace.

2. The reduction of the water content of the coal means that the oven temperature can be raised, carbonization time can be shortened (the use of dried coal shortens carbonization time by about one hour), and therefore coke production can be raised (4.6 metric tons of coke more per day).

3. The specific gravity of the coal loaded into the ovens is increased so that the oven slots are better utilized; dried coal has less openings and the use of 2-3% moisture coal means that 19% more coal can be loaded; an increase of coal loaded means greater production and higher oven temperature.

4. The use of the drying pit means "rain-proof and freeze-proof"; various kinds of washed coal when mixed in the drying pit means that the grain sizes become more even which is beneficial to coke quality.

Distillation chamber contains many treasures -- After the simple coke ovens of the Shih-chia-chuang Tung-li Plant were brought into production, each day the second group of ovens provided a coal tar recovery of 2.5 metric tons. To carry out coal tar processing and provide raw material for crude benzene, the plant made two units of distillation chambers to treat the 2.5 tons of coal tar and make light oil, medium oil, heavy oil, anthracene oil, "hard brick", and other by-products which together add 43,000 yuan output value a year to the gross.

The distillation chamber is 2.5 meters long, 1.2 meter in diameter, and on its top are installed 1.5-meter high refined distillate column, dispersion tube, pressure gage, and charge opening and on its back a bitumen discharge gate. The total volume (capacity) is three tons. Behind the distillation chamber, there is also a circular coil type cooling unit or apparatus, which has a cooling surface of 2 square meters and a water box built of brick, lined inside with a layer of cement, and connected on the bottom to a small hearth (so as to maintain definite cooling temperatures in winter for maintaining normal production). There are two coal tar pumps, one installed inside the cycling pond to transfer oil to the storage area and the other installed inside the storage area to transfer oil to the distillation chamber. The two chambers use a common bitumen pond, which is built with brick and cement and has dimensions of 5.335 meters in length, 2.150 meters in width, and 1.270 meter in height. There is a coal tar storage pond to store the coal tar, and various storage containers for the fractional distillation products.

Coal tar processing: the coal tar from the ammonia aqua cycling pond (from the No. 2 simple coke ovens) are pumped to the coal tar storage container by oil pumps and, utilizing the difference in specific gravity between water and coal tar, the coal tar is rid of water on a preliminary basis and it contains about 4% of water. During distillation the oil pump is used directly to load into the distillation chamber; for safety's sake only two metric tons are loaded at one time; after loading the opening is sealed and fire is ignited to start distillation and, in two hours, the temperature is brought up to 80°F. To prevent oil from escaping without undergoing distillation, a low fire for heating is used at the beginning and the temperature is raised 10°F per hour (in two hours, the water will have been eliminated). At this time, the temperature of the cooling water should

be maintained at about 40°F because naphthalene can plug the pipes when temperature is too low and light oil will evaporate when temperature is too high. Thereafter, temperature is raised 100°F per hour; when temperature is 100-200° the product is light oil and when the temperature exceeds 200°F the product changes to medium oil. For each hour, temperature is raised 180°, and the cooling temperature is not lower than 60°F. The oil flow rate (speed) is 60 kiloliters. When temperature is raised to above 260°, the product becomes heavy oil, which flows at an hourly rate of 70 kiloliters. When temperature is raised to above 310°, the product becomes anthracene oil, which flows at an hourly rate of 84 kiloliters. When temperature reaches 370°F, the fire is stopped and, after two hours wait to have the temperature drop to 240°F, the hard bitumen is taken out (it takes about 40 minutes to discharge this).

The workers at the Shih-chia-chuang Tung-li Plant, after successfully building the distillation chamber, are working toward new goals with great enthusiasm. Now they are adopting various measures to raise product quality and make preparations for producing crude benzene. (Figure 3 in the Figure Appendix shows a coal tar flowsheet.)

12. Native Copper Smelter at Hsueh-shan

No 45, 13 October 1959
Page 50 (excerpts)

Unsigned article

The Tsinghai Province Nonferrous Metals Company was brought into production in September of last year. From a few workers the plant personnel has been increased to more than 1,000 workers. Originally, manual labor was used to blow air; now steam power and electric power are being substituted. A reverberatory furnace has been installed. Within a year, "something has come out of nothing" and the plant is growing from small to big and from native methods to modern methods.

August production of copper matte was 633 metric tons, or 116% of the July output; September production has again risen, being 157% of the August output.

This plant has done exceptionally well through the mass movement centered around technical revolutions and technical improvements. For May and June alone, the staff and workers made 240 items of rational suggestions. As a result of continually improving the furnace structure, production capacity has been greatly improved. During the first quarter when elongated small native furnace built with stone were used, the life of the furnaces was only three days and nights and daily production (per furnace) was only 1.3 metric ton of copper matte. During the second quarter when "bottom large top small shape furnaces of 2.8-meter height" were used, the furnace life was raised to 5 days and nights and daily output per furnace was raised to 2.8 tons of matte. By July another change took place. The furnace body was lengthened to 8 meters in height and three tuyeres were installed; daily production per furnace was increased to 18 metric tons and furnace life was

raised to 8 days and nights. The plant was also successful in mixing 40% fine grain size materials and oxide ore to the mine-run ore for direct smelting; this measure enabled the utilization of large quantities of previously accumulated fine ore. On the premise of further improving techniques, the use of coal during the latter stages was eliminated and the coke ratio was reduced from the original 35% to less than 15%.

The Tsinghai Nonferrous Metals Company in its spectacular achievements is raising high its "Red Flag of high production, good quality, and low cost." During January to September of this year, copper matte production totaled 4,552 metric tons and the year's quota was more than fulfilled three months ahead of schedule. The grade of the copper matte has been raised from last year's 28% (Cu) to 32-35%; costs have been reduced more than 7 times since last year. Now the Company has been gloriously selected to attend the National Heroes' Conference as an advanced unit.

13. Leap Forward in Electric Furnace Production

No 45, 13 October [sic], 1959
Pages 58-60 (excerpts)

Ministry of Metallurgical
Industry Iron and Steel
Bureau Office of Special
Steel

Since the leap forward of last year, our country's electric steel production techniques have improved very rapidly and the utilization coefficient for electric furnaces has been raised greatly. In 1958, the national average for the utilization coefficient in electric furnaces reached 22.11 metric tons, or more than a three-fold rise over that of 1952 and a 18.7% increase over that of 1957; further increases are being made this year. In some advanced enterprises, as a result of increasing furnace volume, intensifying smelting, and other measures, their technical indices for production techniques have advanced continually. The Dairen Steel Plant, which was awarded the victory Red Flag banner as the leader in the country's electric furnace operations, attained the utilization coefficient of 39.83 metric tons through cold loading in electric furnaces; its advanced Red Star Youth furnace has attained the peak of 43.734 metric tons. Thus, the utilization coefficient for its cold loading furnaces has reached standards for hot loading [charging] furnaces; this development has opened a new way for cold loading furnace operations. The practice at Dairen of enlarging the furnace volume, raising loading capacity, and intensifying smelting should be widely employed elsewhere to sustain the continued leap forward of electric steel production.

To raise electric furnace production, the first step is to increase the furnace charging capacity. The past practice has been not to exceed design capacity by more than 20%; in other words a 5-ton electric steel furnace should not produce more than 6 tons. But, in order to produce more steel, some plants elevated the furnace gates and loaded 50% more charge so that a 5-ton furnace was able to produce 7.5 tons. The Dairen plant in

adopting this and other measures in equipment improvement has attained exceptional high production.

The smelting time per charge has been greatly reduced, the record in 1958 is 117% lower than in 1955; this year's record is better than last year.

After more charge has been made in electric furnaces, the next step to raise capacity would be to intensify smelting and reduce the smelting time. In electric furnace practice, the past concept has been that smelting time has to be stationary in order for the reaction to be completed and good quality steel assured. Thus, in electric steel smelting, the oxidation time and the reduction time cannot be shortened. In past practice, the oxidation time should be no less than 60 minutes, and the reduction time, no less than 90 minutes; furthermore, other time schedules cannot be altered. Oxidation should not commence until melting is completed; no good steel can be produced unless the time schedules are strictly conformed to. These concepts greatly restrain progress and dampen the spirit of workmen.

The staff and workmen of the Dairen plant, in employing the oxygen method to smelt steel, observed that in blowing oxygen at the end stage of melting in effect has initiated the oxidation action. Thus, starting the oxidation operation at the end of the melting stage greatly reduces the oxidation time. The breaking of the old concept of cut-offs in oxidation and melting periods is a new development in electric furnace operations.

In the reduction stage of electric furnace steel smelting, the past practice has been to use dispersion to rid oxygen -- pass reducing steel slag to indirectly reduce molten steel. This method requires a relatively long time. In the steel battle of last year, the Dairen and Pench'i Steel Plants, after many experiments, succeeded in developing a new combination oxygen removal system involving an "integrated oxygen removal agent, precipitation pre-oxygen removal, and dispersion oxygen removal." After oxidized residue is "caught," integrated oxygen removal agents like silico-manganese and aluminum silico-manganese is added to the molten steel, pre-removal of oxygen is done in the melt, and then reducing residue is made to carry out dispersion oxygen removal. The oxygen removal process is thus greatly accelerated and the reduction time is shortened by more than 50%. At present, through the use of this method, very good quality ball bearing and shaft steels are being made. Through adopting oxygen steel refining, the oxygen removal stage already has a chance of being shortened; this intensifies the reduction stage and shortens the reduction time; through the combination method of precipitation pre-oxygen removal and dispersion oxygen removal, a new way of intensifying smelting has been found.

The oxidation and reduction stages have both been strengthened through the practice of oxygen smelting; the problem becomes how to reduce the smelting or melting time. The key to reducing smelting time lies in transmitting an adequate heat source. In past practice, the only heat source in electric furnace operations is electricity. With the use of oxygen, we have moved one step further. However, oxygen only helps melting when the furnace charge exceeds 1,000°F and part of the charge starts to melt. During last year's leap forward, the Pen-ch'i and Dairen steel plants

adopted the open-hearth furnace practice of heating with coal gas to help melt the charge in the electric furnace operations; high bituminous coal gas along with oxygen is used to create early oxygen-blowing conditions so as to fully utilize oxygen in steel smelting. Through the use of this method, the smelting or melting time can be reduced by about half an hour.

14. Improve Mill Recovery and Raise Concentrate Quality

No 45, 13 October [sic], 1959
Pages 60-62 (full translation)

Ministry of Metallurgical
Industry Bureau of Non-
ferrous Metals Office of
Mining and Milling

Since the great leap forward of last year, under the Party's main line in carrying out the mass movement, the ore dressing units working on nonferrous metals through thought liberation have overcome the superstition of not being able to simultaneously raise recovery and quality and achieve outstanding results in both lines. This not only enables greater integrated utilization of resources and higher production but at the same time also reduces the unnecessary load on smelting equipment, uncovers latent capacity in smelting, and helps lower costs. Take the example of copper concentrates. According to this year's production level, when grade is raised from 10% to 15-20% Cu, because the weight of concentrates and the coke and flux consumption are reduced, in one year it is not only possible to save 3,500 metric ton-kilometer of transportation, but also, without adding new equipment nearly doubles the roasting and smelting capacities. In this manner, aside from saving the country about 5,000,000 yuan of operating expenses, it is possible to save 12,000,000 yuan in basic construction investments in smelting. Thus, the improvement in mill recovery and product quality assures the continued leap forward in the nonferrous metals industries to meet the ever growing needs of the country's economy and therefore is of great political and economic significance.

Accomplishments along this line represent a victory over rightist conservative thinking -- Prior to 1958, mill recovery and product quality problems for the nonferrous metals industries could not be simultaneously solved. Many ore-dressing workers believe that the two factors cannot be simultaneously raised. With this kind of thinking, although recoveries were somewhat raised (comparing 1952 with 1958, mill recovery for copper sulfide was increased from 92% to 97%, for lead sulfide 90% to 92%, for zinc sulfide 79% to 87%, for tungsten concentrate 59% to 80%, and for tin concentrate 54% to 64%), the rises in product quality have not been notable (comparing 1952 with 1957, product quality for copper concentrate was increased from 9.5% to 10%, and for lead concentrate, from 54% to 55%). While lack of experience has some bearing, the main reason for the slow progress was because ore dressing workers were not able to overcome the superstition that mill recovery and product quality cannot be simultaneously increased.

The situation has changed since the leap forward. The slogan of simultaneously raising recovery and quality was created. Through the mass type of technical revolution, the old concepts on techniques have been discarded and results have been good. At the Shih-chui-tzu Mine, by adopting the method of increasing refined concentration and regrinding and remilling of middlings, the copper concentrate grade has been raised from 12-14% to 18-23% and recovery has been stabilized at above 96%. The workers at the Hu-k'eng Mine, in employing grinding in many sections and separate milling of low and high grade ores, have raised product quality to above 65% and attained the highest monthly recovery of 92%. Many new records have been established since August of this year. At the T'ien-pao-shan Mine, many difficulties were encountered in the past because copper, lead, and zinc occurred together; recently, through adding the frothing agent in the ball mills and modifying the flowsheet in refined concentration, recoveries and product quality for all three metals have been simultaneously raised: recovery--copper from 60% to 65%, lead from 76% to 85%, and zinc from 70% to 76%; product quality--copper concentrate from 16% to 22% Cu, lead concentrate from 43% to 50%, and zinc concentrate from 42% to 47%. Results prove that with good political leadership and effective technical measures, mill recovery and product quality can be simultaneously increased.

Our experience in making these achievements are:

1. Firm political leadership in carrying the Party's mass movement policy has been basic in achieving simultaneous increases in mill recovery and product quality. In the spring of this year, the slogan of raising "the big four indices" (mill recovery, concentrate grade, utilization coefficient of grinding machines, and the equipment moving and turning rate) was warmly supported by the masses. Only a few rightists felt that either time was not yet ripe for achieving such results or that the slogan was a pipe dream. Subsequent work results fully refuted conservative rightist thinking. The staff and workmen of the ore dressing plant of the T'ung-kuan-shan Mine, starting from March of this year, carefully discussed and debated the problem of increasing efficiency in milling and made many rational and important suggestions with regard to improving equipment, modifying flowsheets, streamlining operations, and strengthening management. Examples of relatively simple changes which bore good results are: solved the problem of detrimental effect of clayey material in flotation by reducing it in the mine-run ore, grain size of crushed ore was reduced to maintain definite capacities in grinding and avoid the need for adding screening area facilities; to raise product grade, the practice of "many times refined concentration" was emphasized; and to improve recovery rate, separate regrinding and reconcentration were done. Within three months after these changes were made, the grade of concentrates was raised from 8-10% (Cu) to 15-20%, the recovery rate was upped from 91% to 93%, and other major technical and economic indices, including the equipment moving and turning rate and the utilization coefficient for grinding, greatly improved. These results show that with good political leadership to guide mass efforts in pioneering technical work, successes can be achieved in all fronts.

2. Put to wide use advanced experiences and improve mill flowsheets. Measures of this nature are basic to raising technical levels in ore dressing. The high magnesium problem of copper concentrates from the Shou-wang-fen Mine was not solved for several years and seriously affected coke consumption in smelting and created bad working conditions in the performance of the blowers. In April of this year, through mass discussions, adoption of proven practices elsewhere, and adding one more cycle in refined concentration to the original flowsheet, the magnesium content of the concentrates was lowered from 8-10% to less than 4% and the grade of the copper concentrate was raised from 16-18% (Cu); recently, by changing one-stage grinding to multiple stage grinding, recovery was increased by 2%. The ore dressing plant of the P'ing-kuei Company, through adding the Humphrey spiral to strengthen the alluvial tin flowsheet, raised the recovery rate from 55-60% to 80-85%. Various tungsten mines, in more widely employing the advanced experiences multiple stage grinding and separate milling in lean and rich ores, have raised recovery rates from 75% to 88%. Actual practice has proven that concentrate production and quality can be simultaneously raised through adopting advanced techniques such as multiple stage grinding, milling in separate stages, "many times refined concentration," separate grinding and concentration of middlings, adoption of coordinated or integrated milling-smelting flowsheets, and using the Humphrey spiral, etc. It should be pointed out that the advanced practices suggested by Soviet specialists are very applicable to our conditions and should be widely employed by various ore-dressing plants.

3. Strengthen scientific research to improve ore-dressing practice. To improve recovery and product quality, it is necessary first to examine the characteristics of the minerals, production flowsheets, and operating conditions to find out the problems. Then, the "suitable medicine" can be applied in the form of adopting the necessary advanced experience and making appropriate changes in flowsheets and methods of operation. Strengthening scientific research is important in this regard. Why has the T'ung-kuan-shan ore dressing plant been able in a very short time achieve good results in recovery and product grade? The plant made experiments and found out that the cause of low concentrate grade was due to much iron sulfide and copper-gangue "connecting bodies" in the concentrate. The original "one-time refined concentration" was changed to "two-time refined concentration" and, during the reconcentration stage, cyanogen materials were added to eliminate iron oxide and other impurities; also, the refined concentrate tailing was reground and remilled and the copper in the "impurities" was retrieved so as to raise the overall mill recovery. Small scale experiments led to full scale adoption. This example effectively demonstrates the importance of research to raising technical levels and improving technical and economic indices.

4. Strengthen management work. An important aspect in continually raising work performance is the establishment or improvement of the "responsibility system," the strengthening of equipment maintenance and repair, the strict adherence to operational regulations, and the adoption of the overlapping shift system. It should be stressed that good management must be

coordinated with mass efforts in making sure that regulations and systems are practical enough to be effectively carried out. Already established regulations and systems must change according to improving production conditions in milling operations so that output can incessantly move forward.

15. Do Well in Small Aluminum Plants to Accelerate the
Development of the Aluminum Industry

No 46, 20 November 1959
Pages 28-31 (excerpts)

Editorial

Since the great leap forward of last year, particularly after the central directives regarding expanding copper and aluminum production, the aluminum refining industry assumed a new complexion. The 1958 national output of aluminum was 69.5% over the 1957 output. During the first three quarters of this year, production was 23.7% higher than that for the similar period of last year. As a result of implementing the policy of large, medium, and small enterprises and modern along with native plants in the aluminum industry, production of ingots is no longer by a few large enterprises. Many small plants have been established in all parts of the country. For the estimated new aluminum capacity added this year, more than thirty percent will be in the form of small plants. By next year, it is expected that 20% of the country's aluminum output will be furnished by small plants. This should greatly accelerate the development of our country's aluminum industry. It is obvious that small plants are becoming of considerable importance to the growth of the aluminum industry.

The development of the aluminum industry has been very rapid during the last ten years, particularly in the last few years when the average increase in production rose by about 50% each year. Yet, the aluminum industry has not been able to satisfy the growing needs of the economy; the shortage has been particularly felt since last year's great leap forward.

The small aluminum plants built during the leap forward period had many obvious advantages, among which is the fact that they could make use of widely dispersed power resources. Many power systems have been established in our country, including water power and thermal power stations such as Huai Ho system's Mei-shan and Fu-tzu-ling water power stations, Kan Chiang system's varied sized hydroplants, and the thermal plants in various large and small cities and industrial areas. Establishing small aluminum plants to utilize either existing or to be developed power sources in scattered areas not only does not involve great additions in power facilities but also may mean that the aluminum plants can be built near the power source to save on transport. Many small aluminum plants will greatly accelerate aluminum production. Materials and equipment needs for building small aluminum plants are relatively small and can be easily solved; investment requirements are also small, a 1,000-ton per annum capacity aluminum plant costing only about 1,400,000-1,500,000 yuan to construct. Brick electrolytic cells can be substituted for steel cells; with regard to the degree of mechanization,

relatively simple but effective measures can be adopted. The small plants can be built very quickly and operations are simple--construction generally takes about 5 months, and in the case of the Peiping experimental aluminum plant construction took merely 40-odd days. In contrast, it takes more than two years to build medium and large plants from design to production. Building of many small aluminum plants can help train a large corps of specialized technicians very quickly. For example, workmen from the small plants built during early years have been sent to help construction of other plants, both small and large. Some testing work which cannot be done in large plants are conducted in small plants; thus, the small plants also contribute greatly to the overall improvement of aluminum production techniques.

Although the building of small aluminum plants started less than a year ago, much experience has already been accumulated. We have already mastered the techniques of not using "carbon lump" electrodes through substituting paste, not using regulated transformers, and brick built electrolytic cell operations. Thus, progress in small aluminum plant operations have been very rapid and production has risen, quality has improved, power consumption has been reduced, cost lowered, and the life of cells lengthened. Many of the small aluminum plants have achieved good technical and economic indices; for example, the electric current efficiency at the Cheng-chow small aluminum plant reached 87.29% in September. As the aluminum industry advances, the small aluminum plants can be expanded into medium scale operations to become more important in production.

Is it true that small aluminum plants cannot produce good aluminum? The example of the Cheng-chow small aluminum plant proves that this is entirely possible; during September, 94.82% of its output met specifications and 15 cells were producing first grade aluminum and 2 cells were producing special grade aluminum. Small plants have trouble in quality when first started, but this is no different from big plants. Besides, the anode paste used by small plants generally contains more ash (6-12%) than that used by large plants and workmen are far less trained. When the Cheng-chow plant came into production in June, the aluminum produced was almost all subgrade and by September 94.82% met specifications; also, first grade aluminum was produced in a few months time at the Lan-chow small aluminum plant and by September 77.415% met the specifications. Two months after the T'ang-shan aluminum plant got underway, 67% of the aluminum had met specifications. It is seen that quality is not a function of plant size or cell size; those who criticize small plants as being unable to produce good aluminum are not basing their arguments on facts.

Small aluminum plants naturally cannot be perfect in the early stages of operation. But to say they should be eliminated just because of poor performance at the start would be a great mistake. The development of the Peiping experimental aluminum plant illustrates the rapid improvement that can take place -- the plant's electric current efficiency has been raised from 55% to 85% and electricity consumption per metric tons of aluminum ingot has been reduced from 40,000 kwh to 29,000 kwh. The Cheng-chow plant has achieved even more remarkable results; during September, its electric current efficiency reached 87.29%, average cell voltage reached 6.39 volts,

power consumption per metric ton of ingot was lowered 21,800 kwh, and anode paste consumption was lowered to 538 kilograms. Better and better results can be expected for small aluminum plant operations in the future.

Some say the life of cells for small aluminum plants is too short. This is again not true. The two earliest cells built at the Peiping plant are still working very well after a year of operations. Although 20% of the cells have had some repairs, there has been no serious trouble. Not a single cell of the Peiping plant had to be fixed in the first three months, those that underwent major repairs in 3-6 months represented 12% of the total, and those that underwent major repairs after 6 months represented 66%. Other small aluminum plants, through profiting by the experience of the Peiping plant have been performing even better. We can say that brick cells definitely can have a long life.

Some say that small aluminum plants are too costly to operate. We say that costs are a little higher than large plants because of the short history of small plants and lack of experienced management personnel. The power used by the small aluminum plants is usually thermal and its cost could be 2-3 or even 5-6 times the cost at large plants. For many small plants, not all cells are as yet in operation, hence the management charge per ton is relatively high. However, with better management and operational conditions, greater familiarity of workmen in the work, and larger number of cells in operation, cost should steadily decline. For the Cheng-chow plant, in three months (July to October) cost was reduced by 39%; and for the Peiping plant, cost has been reduced by 27% since the start of operation. The cost of products from small plants is approaching that from large plants during their initial stages of operations; further cost reductions can be expected for small plants in the future. Any enterprise must undergo a period of high cost operation; it took the large plants several years to reach their present levels of cost; why should not the small plants go through the same process. The above descriptions clearly indicate that small aluminum plants have great possibilities.

The records established by small aluminum plants cannot be refuted. In three months after the Party's Eighth Plenary Session, nine small aluminum plants were already brought into production. Many other small aluminum plants will be completed in the near future.

16. Principal Measures Taken in Attaining High Production,
Good Quality, Low Consumption, and Long Life
in Small Aluminum Plant Operations

No 46, 20 November 1959
Pages 35-38 (full translation)

Unsigned article

During the National Small Aluminum Plants Conference held at Cheng-chow and sponsored by the Ministry of Metallurgical Industry, experiences were reviewed and measures for attaining high production, good quality, low consumption (materials and power), and long life for small aluminum plants were formulated. Major points are as follows:

1. Raise the current

The higher the current, the greater the production. Under definite conditions, raising current not only increases production and utilizes equipment capacity better but also has a good effect on improving electric current efficiency, maintaining the heat balance for the small cells, and lowering power consumption, which ultimately means higher production and lower costs. At the present time, the self-heating Soldergerg type anode electrolytic cells employed at various plants are of two types -- 5,000 and 10,000 amperes. The designed current density is about 0.95 ampere per square millimeter, but many plants cannot yet attain this level; hence, an important step would be for the plants to quickly attain in excess of 5,000 and 10,000 amperes. For those small plants with favorable conditions, low temperature operations should be developed along with higher current so that the electric current density would be gradually raised to 1.2 ampere per square millimeter or more.

2. Establish more cells

On the basis of better utilization of mercury rectifiers, try to operate as many electrolytic cells as possible. This not only will enable greater production, but will also raise the utilization rate of electric equipment, improve the efficiency of rectification, increase the load factor, reduce electricity consumption, and consequently lower costs. However, one of the objectives of employing more cells is to reduce cell voltage or pressure. Hence, "anode work" must be strengthened in the way of lengthening the turnover cycle, improving and cleaning contact points, reducing precipitation, and strengthening temperature maintenance with a view to lower cell voltage to about 6.3 volts and possibly to below 6 volts. Also, efforts should be made to increase the number of cells in a series to 100, if not more than 120.

3. Maintain four lows (low molecular ratio, lower effective reaction coefficient, low electrolyte level, and low temperature)

Low molecular ratio -- To accommodate high current operations and characteristics of small scale brick cells in maintaining low temperature and high current efficiency conditions, it is necessary to keep the sodium fluoride to aluminum fluoride ratio at about 2.3.

Low effective reaction coefficient -- When reaction develops, large quantities of electrical energy and materials are required and violent fluctuations in cell temperature take place. Therefore, by controlling the effective reaction coefficient to less than 0.1 will mean great savings in the consumption of electrical energy and materials, stabilization of cell temperature, and increases in production.

Low temperature -- By maintaining low temperature operations, unnecessary heat losses can be reduced so that losses in raw materials and metallic aluminum will be correspondingly lowered and a good effect will result in the quality of the aluminum made. Usually, the best temperature to maintain is about 910°.

Low electrolyte level -- By maintaining a low electrolyte level, the electric current efficiency can be raised and, more important, brick cell characteristics can be accommodated to reduce leakage, prolong cell life,

and reduce consumption of fluoride salts. However, during operations it is necessary to be careful in charging materials. Not too much alumina should be added at one time to cause precipitation. Generally, it is best to keep the electrolyte level at 10-15 centimeters.

4. Stabilizing conditions

The characteristics of the small electrolytic cells are that the heat dispersion surface is relatively greater, heat content in the cell is a little lower, and when excessive technical changes take place the cells are apt to deteriorate and production will become abnormal. Therefore, technical conditions must be stable in small cells in order to assure stability in production. In the future, it is necessary to make further investigations in finding even more suitable conditions to fit small brick cell characteristics.

5. Regularly shaped furnace pots

Regularly shaped furnace pots are an important condition in attaining high production, good quality, low consumption, and long life for aluminum electrolysis operations. When the shape is regular, the cell temperature is even, cell troubles will be reduced and current efficiency and electric energy efficiency will be raised. To form well-shaped furnace pots inside the cells, the gradual growth in the initial stages is important to assure strength and even distribution. Normally, the methods of local shaping and controlled material charging are employed and special people are assigned to clean and keep the anodes in good shape so as to form regularly-shaped furnace pots.

6. Maintain "three cleans" (clean tools, clean surroundings, and clean materials)

In the electrolysis of aluminum, there is no process for ridding impurities and the quality of materials produced is primarily determined by the impurities that enter the cell. Therefore, attention should be placed on improving the brick platform, improving the weighing mechanism, adding a cap to the anode, water washing of anode paste, keeping out impurities from tools and extraneous materials, and using low-impurity raw materials.

7. Establishing "mother cells"

In charging electrolytic cells, if recovery of secondary materials is not done there will, of course, be much loss in raw materials so that unit product requirements will be high. Therefore, in employing the "establishment of mother cell method" to concentrate charging into definite "mother cells" rather than in all cells would prevent quality from being greatly affected.

8. Be diligent in inspection, adjustment, changing implements, and plugging leaks

There is not a voltmeter for each small electrolytic cell. Therefore, deligency in inspecting the operating voltage and making adjustments when it rises too high is imperative in maintaining steady low voltages.

During the process of electrolysis, the molecular ratio often gradually rises because of the volatile nature of aluminum fluoride. Hence, it is necessary to inspect the electrolyte composition diligently and be prepared to make adjustments in order to maintain stability of electrolyte composition.

During operations, when tools become red they should be changed to avoid too much iron being melted or dissolved in the electrolytic cell so as to affect product quality.

Small scale brick made electrolytic cells are relatively easy to develop leakages. This not only causes much loss in fluoride salts but when unattended also means that the holes will become larger and therefore will greatly shorten the life of the cells. Therefore, strengthening inspection and maintenance with regard to cracks and leakage is very important.

9. Further processing to produce aluminum must be rapid and careful. On the premise of assuring good product quality, accelerating operations means avoiding opening the top for too long, causing much heat loss, and reducing the contact time between iron implements and the electrolyte (so that less impurities will get into the cells). Normally speaking, further processing should take only 3-5 minutes, vacuum production of aluminum less than 3 minutes, and "niu-chiao" (bull horn) production of aluminum 8-10 minutes.

10. Definite quantities of materials, definite time in further processing, and definite periods to produce aluminum

Charging definite quantities of materials and applying further processing according to definite time schedules are important measures in maintaining cell stability, reducing fluctuations in quality, and preventing anode reaction (controlling the effective reaction coefficient to below 0.1). Generally, definite quantities of materials should be charged every 6-8 hours and further processing must also be done according to schedule.

Taking out the aluminum according to specific time schedules is absolutely necessary in maintaining "metal levels" and stabilizing technical conditions. To avoid excessive fluctuations in small cell operations, generally aluminum should be taken out once every "two nights and days."

11. "Fish" for carbon residue as little as possible

By not doing this very much, raw material losses can be reduced, contact time between iron implements and electrolyte can be shortened, and heat losses minimized. However, when it is necessary to take out carbon residue in the final stages for some cells, it is better to open holes to do the fishing just before the further processing stage so as to avoid excessive heat losses.

12. Cell repair should be quick and good

The electrolytic cell is a principal piece of equipment in the electrolysis of aluminum. When work quality is not good, not only is the life of the cells and their production greatly reduced, but technical and economic indices, product quality, cost, and electric energy consumption will also be greatly affected. Therefore, while it is important to do repair work quickly it is also necessary to stress work quality as follows: (1) Brick cracks should not be greater than 5 mm and cement paste must fill all cracks. Otherwise, carbonaceous materials exposed in the linings will cause rapid oxidation and deterioration, particularly in the side parts. (2) The cement mix must be according to definite proportions. (3) In pouring "fixed bottom paste", cleanliness is important; also, temperature conditions must be satisfactory and materials must be even in size. Sometimes, there is too

much air in the paste and expansion and contraction may cause cracks. (4) The steel rod of the anode must be cleaned thoroughly; contact points must be soldered to attain the least reduction of voltage. Otherwise, after operations are started, much electrical energy will be lost (affecting cost and power consumption) because the voltage drop in the bottom of the cells is great for long periods of time.

13. Unified operations

The continuity nature in aluminum electrolysis is important, although further processing procedure may vary. Also, operations must be unified. Three shifts must cooperate closely, and turning over of the work must be "clear." Continuity in stability of cells must be maintained to assure good results.

14. Strengthen technical management

Establish necessary regulations, such as operational standards, safety standards, and standards related to rectifier performance. Good records on technical conditions and indices are necessary. Techniques should be often reviewed. Inspection, analysis, and repair work must be strengthened.

15. Strengthen operational management

Do good cost accounting work for shifts and groups, develop contests among sections, strengthen supervision of raw materials by various levels, try to prevent impurities from entering cells, and avoid wetness. With regard to the policy on prices, assign prices according to product quality so as to encourage production of better grade aluminum.

16. Safe production

Strengthen safety measures, do well in safety education, and make sure of safe operation of equipment.

17. Greatly Reduce Aluminum Ingot Production

No 46, 20 November 1959
Pages 38-39 & 31 (full translation)

Financial Bureau
Nonferrous Metals
Division

At present, small aluminum plants are being built in many areas of the country. Those already brought into production have proved their worth within a few months. Output has gradually risen, quality improved, consumption (power and raw materials) lowered, and ingot cost reduced. In this article, we shall discuss problems related to production cost in small aluminum plants.

When small aluminum plants are first brought into production, high costs are temporarily encountered. Later, as operations progress and various technical and economic indices are improved, costs are naturally lowered. Based upon several plants already in production (Cheng-chow, Lanchow, T'aiyuan, etc.) ingot production costs have been reduced 23-26% within 3 months. In the case of the Cheng-chow plant, the cost in October was more than 39% lower than that in July. Henceforth, if management in

operations is further strengthened ingot cost for small aluminum plants can be greatly reduced.

1. Consumption of electric power and fluoride salts can be substantially lowered -- At present, consumption of aluminum and anode paste in small aluminum plants is already approaching current large plant standards. However, because equipment is not as good and workmen are not yet too familiar with operations, present consumption of electric power and fluoride salts is still relatively high. These are the key factors in cost reduction. In the case of electricity per metric ton of ingot, consumption at the T'ai-yuan plant in September was reduced to 24,300 kwh whereas other small aluminum plants may still be as high as 29,000 kwh. In the case of fluoride salts per ton of ingot, consumption at the Lanchow plant has been lowered to 172 kg as compared with the high of 340 kg in other plants. The disparity is obviously great. By the same token, the potential that can be uncovered in small aluminum plants along these lines is also great. The methods are to improve cell construction quality, modify cell structure, and steadily raise technical and operational levels through employing lower temperatures, lower electrolyte levels, and lower molecular ratios (sodium fluoride to aluminum fluoride), reducing voltage drops at cell bottoms, pushing "no effective reaction" (coefficient at below 0.1) operations, raising electric current efficiency, and reducing cell voltage, etc. By so doing, electricity and fluoride salts consumption can be greatly reduced. At the Cheng-chow small aluminum plant, the direct current consumption in September was already reduced to 21,800 kwh per metric ton of aluminum. At Nan-ch'ang-fang in October, the figure was 20,387 kwh. Although the consumption of fluoride salts at the Peiping small aluminum plant is still relatively high from the overall stand point, for some groups of cells the consumption has been lowered to below 150 kg. Thus, to lower DC current to about 20,000 kwh and fluoride salts consumption to 50-200 kg are entirely possible. These two items alone can mean cost reduction per metric ton of aluminum ingot of about 500-1,000 yuan.

2. Brick constructed cells are aiming at longer life, and major repair and trial run costs can be greatly reduced -- Experience at the Peiping plant show that brick-built small electrolytic cells cannot function normally for too long periods; major repairs are necessary every 8-9 months and each major repair requires heating up and restarting. The average major repair and trial-run cost for the Peiping plant during the first three quarters reached 1,324 yuan per metric ton of aluminum; at the Cheng-chow plant, this combined cost totaled 892 yuan. However, according to the experience at these two plants (for example, some cells at the Peiping plant have been used for more than a year without damage, and the first batch of cells at the Cheng-chow plant in operation for nearly six months since the start are essentially in good shape and have seldom changed form), as long as the operational quality for the cells is good, cell structure is continually improved, starting methods are suitable, and inspection and repair work is strengthened, cell life definitely has possibilities of being extended to a year and a half or even beyond two years. Also, through raising overall production and cutting down on major repair and restarting

costs, the total cost for these two items can be lowered from more than 1,000 yuan per metric ton of aluminum to possibly below 300 yuan.

3. Price of direct current (cost of DC current per kwh) can be greatly reduced -- The various small aluminum plants, because they are still in the stage of half production and half construction, and the cells in operation represent on the average half of the proposed number, cannot as yet fully exert themselves. Since electrical equipment like transformers and rectifiers, etc. are not fully utilized, the energy utilization ratio and rectification efficiency are relatively low so as to raise the cost for the direct current. At the Cheng-chow small aluminum plant, the price of alternating current is 9 cents (1/100 of yuan) and, because not enough cells were operated in August (58 cells operated in early stages of production) the energy utilization ratio was only 55% so that the DC current cost became 17 cents; when 110 cells were run in October, the energy utilization ratio was increased to 86% and DC current cost was lowered to 11 cents per kwh. For this item alone, the cost reduction per ton of ingot was 395 yuan as compared with the figure in September. Thus, through rapid construction of more cells and fully utilizing the latent capacity of equipment, electricity cost can be greatly reduced even on the basis of similar unit power consumption.

4. Much savings can be made in management charges -- Management cost has been relatively high because plants have not been completed for too long a time and management lacks experience. Control of raw materials is not so good and much loss results. At the Peiping plant during the first half year and for the item of alumina alone, 29 tons were not accounted for which meant a rise of nearly 100 yuan per metric ton of aluminum ingot. Also, because some small plants have not yet been producing for too long and the potential capacity has not been fully utilized, the share of operating and management costs per unit of ingot is still relatively high, amounting to about 300 yuan (excluding major repair and trial-run costs, same applies to item below) for the best plants and more than 1,200 yuan for the worst ones. However, as management is streamlined and production is raised, the management cost can be reduced to below 300 yuan. For example, for the Peiping plant, if production can reach design levels and some auxiliary units can be expanded (such as the anode paste and aluminum processing units, etc.) and brought into production, the overall management cost can be reduced from the figure of 389 yuan for September to less than 100 yuan.

Summarizing the above analysis, it is entirely possible to greatly reduce costs through a year or two of hard work in steadily improving operational and management standards.

Can we make these possibilities into realities? The answer is a definite yes. The Cheng-chow small aluminum plant is a good example. During October the cost per ton of ingot was reduced 21% below the September cost. Now, the plant is striving for further cost reduction in 1960. If raw material and power prices can be calculated according to price levels for large plants, overall cost for small plants can be lowered to large plant levels next year. This is a very significant matter. What the Cheng-chow small aluminum plant can achieve can be achieved by other small plants after

a period of hard work. As long as there is the work spirit to strive for the upstream and the thought to improve on and develop new circumstances, the ingot cost for small aluminum plants can, in a year or two, be lowered to levels approaching those of large plants. These objectives can be realized.

Figure Appendix

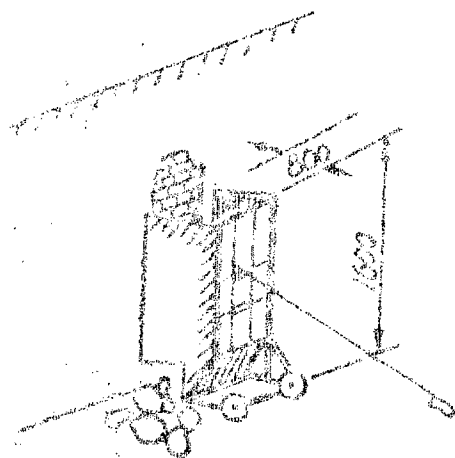


Figure 1. Structure for Unloading Coke
(article 11)

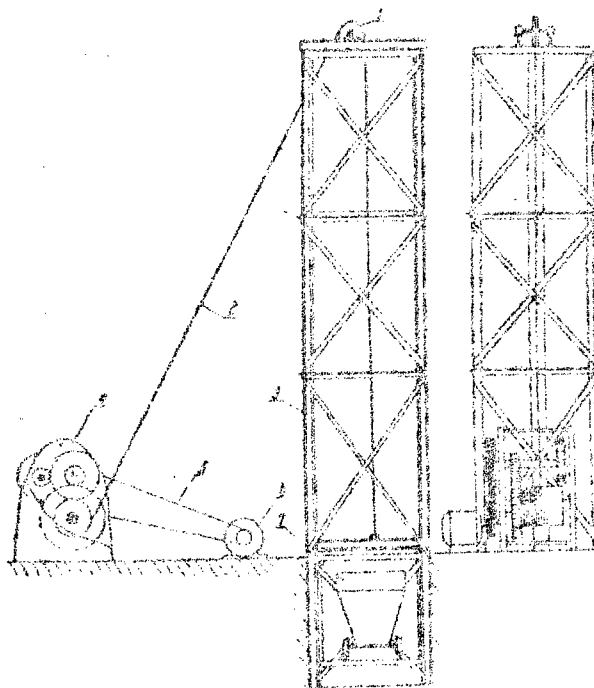


Figure 2. A Vertical Type Coal Loading
Electric Elevator (article 11)

Notations

- | | |
|------------------------------|--------------------|
| 1. Pulley | 5. Triangular belt |
| 2. Steel cable | 6. Electric motor |
| 3. Frame | 7. Coal car |
| 4. Speed reduction equipment | |

